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ABSTRACT

This report discusses the govenment role in higher education in the United States, particularly in relation to the contribution the state and land-grant universities can make in providing answers to a number of seemingly intractable problems which the country must solve in order to maintain its economic and political position in the world. The history of the governmental role in developing state and land-grant universities is reviewed, including the effects of the Morrill Land-Grant Act (1857), the Hatch Act (1887), and the Smith-Lever Act (1914). Next examined is the role of education in the nation's overall competitiveness, including brief discussions of some of the trouble spots, such as weaknesses in the development of basic educational skills, scientist-engineer shortages, lack of minority outreach, and teacher-faculty shortfalls. Finally, the role of land-grant and state universities in specific areas of national need is discussed and recommended governmental actions are suggested to help resolve these needs. Areas examined include agriculture and food production; the health of the nation's cities and urban populations; protection of the environment and natural resources; international relations; research; and the development of the nations' citizenry, including all minorities. Specific recommendations include enactment of the National Initiative for Agricultural Research, expansion of commitment to urban campuses reflected in the Partnerships for Economic Development and Urban Community Service program, increased funding for marine research and technical assistance, increased resources to foreign language and area study programs, maintenance of student financial aid services, recognition of the historically public black colleges, and support of high quality scientific and engineering research programs. (GLR)

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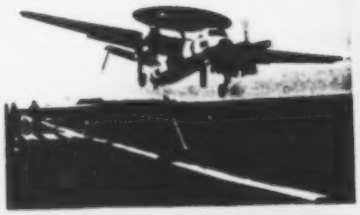

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"Upon the subject of education. . .
I can only say
that I view it
as the most important subject
which we as a people can be engaged in."

Abraham Lincoln
1832

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The Essential Partnership

A new legislative season began in 1989.

The 101st U.S. Congress convened, welcoming 10 new Senators and 33 new Representatives to the 535-member federal legislature.

The 41st U.S. president moved into the White House, promising to be "the education president."

And, four new governors took office, joining 46 other state chief executives, and thousands of other state and local lawmakers and public administrators concerned with an eclectic set of issues, ranging from education and international trade to garbage collection and public safety.

Now that the votes have been counted, the muck and mud have been wiped off the nation's ballot box, and the pundits have dissected America's political psyche—it is time to get down to the business of government.

But that won't be easy.

Political Insurance Policy

Once again, the American people have written themselves a political insurance policy at the polls—the two ends of Pennsylvania Avenue, the White House and Capitol Hill, are governed by different parties; many governors and state legislators face a similar circumstance; and, liberals, conservatives, and moderates populate the Democratic and Republican parties, reflecting the electorate's wide range of tastes and attitudes . . . the time-honored maxim that "all politics is local" . . . and, America's congenital disdain for concentrated power.

And, once again, divided government is faced with the seemingly intractable problems associated with a chronic issue that has for years dominated the public agenda: federal finances.

Lawmakers and the new administration are facing the spectre of the federal government's $2.4 trillion debt—a staggering mortgage doubled in just eight years, with big-buck IOU's held by bankers in far-flung capitals like London and Tokyo. The nation's ledger also is sullied by the prospect of huge annual deficits, despite the deficit-cutting targets set by the Gramm-Rudman-Hollings balanced-budget law.

With interest on the federal debt nudging passed the $160 billion mark—an amount equal to about one-third of U.S. tax revenues—options will be narrowed considerably for the new administration and Congress. And, one option, a tax increase, is viewed in many quarters as something akin to gulping a political poison pill. Additionally, Capitol Hill and the White House awaited the fiscal fig leaf crafted, sometimes raucously, by the bipartisan National Economic Commission—a year-long quest that ended in deadlock.

At Home and Abroad

The nation's woes also are complicated by baffling problems at home and beyond America's shores: a decade ago, the United States was the world's largest creditor—now it's the largest debtor nation in history . . . crime seems rampant, and many murders and muggings are closely tied to the nation's illegal drug binge . . . America's air and water are tainted . . . the nation's highways are clogged with gas-guzzling traffic and much of its roads, bridges, and infrastructure appear to be crumbling . . .

. . . while the United States boasts the world's best medical technology and care much of it seems, to the ill and elderly, beyond the reach of their wallets . . . cures for plagues like cancer and AIDs remain elusive . . . affordable housing appears increasingly scarce, while the numbers of panhandlers and homeless are more plentiful on the nation's boulevards and in its al-

leys . . joining the homeless on the streets are legions of teenagers—especially Hispanics and blacks—who not only have dropped out of school, but are well on their way to dropping out of life . . . and, after spending more than $300 billion a year on education, the United States has discovered that less than a quarter of its students know when Abraham Lincoln was president.

Yet, as the new political season begins there is much in America to cheer as the nation continues its experience, and experiment, with "government of the people, by the people, and for the people." America's freedom, economic prosperity, and education system are the envy of the world. U.S. scientists, on many fronts, are unlocking the mysteries of nature, while engineers are harnessing the technology that makes life easier and more fulfilling. America also is an acclaimed leader in a broad array of performing, visual, and written arts. And, the globe seems a bit safer as the superpowers methodically scuttle—for the first time—an entire family of nuclear weapons and the world gazes intently at a Kremlin infected by *perestroika* and *glasnost*.

Countdown to Tomorrow!

In grappling with the nation's complicated agenda, lawmakers and leaders must keep a firm fix on the 21st century, now just 11 years away. Today's problems must be measured against the demands and challenges of a new century.

Futurists have gazed into their crystal balls—computer models, mathematical equations, scientific formulas—and their imaginations, trying to peer into the future to see if it works.

What some of them see is a brave new world where genetic engineering will give birth to artificial blood, growth hormones, drugs to sharpen human memories, disease immunities for babies, and other life-stretching innovations.

Surgery, in many cases, will give way to computer-based diagnostic tools, while "bloodless" surgery becomes more common through expanded use of lasers. And, victims of head injuries and retardation may be aided by experimental brain cell and tissue transplants early in the 21st century, while laboratory grown bone, muscle, and blood cells will be used in transplants.

Artificial intelligence is likely to be widely used by business and government to help gather information and solve problems. Manufacturing industries, relying on more automation and robotics to ease production, may experience a quantum-boost in productivity. Increased use of "smart" weapons may tend to trim the nation's military personnel requirements, but also expand America's reliance on advanced technology for its security.

Eighteen percent of U.S. homes now have computers—by 2001, 70 percent of U.S. homes may have computers, greatly changing the way Americans go to school, work, shop, bank, vote, file income-tax returns, and take care of their health needs. Computers will open the card catalogs of the world's libraries to readers, who are likely to scan encyclopedias, other reference volumes, and manuals by peering at computer screens and not printed pages. Magazines also may be available on computer disks, permitting readers to manipulate information on personal computers.

And, what of superconductivity and the vision of high-speed trains racing along above their tracks and huge coils of wire able to store almost limitless quantities of electric power endlessly? The possible wonders of superconductivity—the ability of some materials to conduct electricity with virtually no resistance when cooled to extremely low temperatures—has set scientists on a search for new substances capable of such properties, but at much higher and economical temperatures.

The world of the 21st century also is likely to yank *Buck Rogers* and *Flash Gordon* out of the world of science fiction and into the world of science as astronauts, engineers, and scientists live aboard the $23 billion space station *Freedom*, orbiting high above the Earth; build a colony on the moon, and perhaps a U.S.-Soviet crew will explore the mysterious red planet Mars. Back "above" Earth, tourists and business people are likely to shuttle between New York, Tokyo, and other distant cities aboard the *Orient Express*, a sleek supersonic airliner, flying between two and five times the speed of sound at the edge of space.

The complexion of America's schools and society also will change by the turn of the century. *One-Third of a Nation: A Report of the Commission on Minority Participation in Education and American Life*, a 1988 study by the Education Commission of the States and the American Council on Education, noted that by 2000, one-third of all school-age youngsters will be black, Hispanic, American Indian, or Asian-American; about 42 percent of all public-school students will be minorities or victims of poverty, and that 21.8 million of the 140.4 million people estimated to be in the U.S. workforce will be non-white.

Workforce 2000: Work and Workers for the 21st Century, a study commissioned by the U.S. Department of Labor, observes:

"Among the fastest-growing jobs, the trend toward higher educational requirements is striking. Of all the new jobs that will be created over the 1984-2000 period, more than half will require some education beyond high school, and almost a third will be filled by college graduates.

"Between now and the year 2000, for the first time in history," the report continues, "a majority of all new jobs will require postsecondary education. Many professions will require nearly a decade of study following high school, and even the least skilled jobs will require a command of reading, computing, and thinking that was once necessary only for the professions."

Federal Role in Higher Education

Whether the United States reflects on its current litany of problems or looks ahead to the challenges and opportunities of a new century, it is clear that education is a key to the nation's well-being.

As the federal role in society continues to be reshaped, education should continue to be among Washington's appropriate responsibilities; the historic "essential partnership" among the nation's campuses and government should be *nurtured, broadened, and strengthened.*

A White House report in the mid-1980's noted: "America has a unique dependence upon its colleges and universities both for new knowledge and for young minds trained to use this knowledge in innovative ways; the excellence of our colleges and universities has been a cornerstone of our economic well-being, our national security, and the health and quality of life of our citizens."

U.S. policy toward its colleges and universities should take a cue from a quip by the vaudevillian vamp Mae West, who said: "Too much of a good thing can be wonderful."

Education: A Nonpartisan Issue

Education is a national issue; education is a nonpartisan issue.

Countless public-opinion polls have reported general faith in and support of colleges and universities. Pollster Louis Harris told Capitol Hill lawmakers in September, 1987, that big majorities—70 percent to more than 90 percent in various canvasses—agree that the U.S.

ability to compete internationally depends on the country's ability to create a well-educated work force staffed by creative thinkers. Similar majorities, Harris says, favor "increasing spending on education to make minority students fully productive members of the labor force . . . In advocating this . . . people see it as a matter of their own and the country's survival . . . *most Americans see . . . radical change in education as the biggest key to making the country competitive again.*"

During Campaign '88, George Bush remarked: "Education is the most important basic issue facing America; it affects numerous pressing issues in today's society—poverty, drugs, crime, unemployment, productivity, economic development, and international competitiveness . . . Education is the great lifting mechanism of an egalitarian society. It represents a proven pathway to a better life."

There was agreement on the other side of the aisle, too. The 1988 Democratic party platform declared: "We believe that the education of our citizens, from Head Start to institutions of higher learning, deserves our highest priority and that history will judge the next administration . . . by its success in improving young minds . . . We believe that this nation needs to invest in its children on the front side of life . . ."

And, education is the No. 1 priority of the nation's 50 governors, according to the Council of State Governments. For example, Democrat Cecil Andrus, governor of Idaho, said: "We either help our children become responsible and self-sufficient, or we will pay, and pay dearly to provide many of them with welfare or put many of them in jail." Republican James Thompson, governor of Illinois, noted: "If our children are to compete for the jobs of tomorrow, we must provide the best of educations today . . ."

Battles Over Priorities

Upcoming battles over national priorities will take place against the backdrop of divided and partisan government, limited financial resources, and competing claims argued loudly and vigorously by interests determined to champion parochial portions of the national agenda.

While the higher-education community is not immune, at times, from provincialism, its over-arching interest is to spur development—through classroom instruction, laboratory research, and public-service programs—of those resources and capacities that will aid the United States in achieving its goals of economic prosperity, national security, and general welfare.

Consequently, public officials at all levels of government are cautioned against opting for short-term, bottom-line policies that will mortgage the nation's long-term prosperity, security, and welfare.

While the "D" word, the deficits—federal budget and trade—will cloud the federal-budget process for years, legislators and public administrators should have a keen understanding of the *clear distinction between a consumption expenditure and an investment expenditure that is in the public interest.*

It is good economics to borrow for an investment—such as education—but borrowing to support consumption is far less of a bargain.

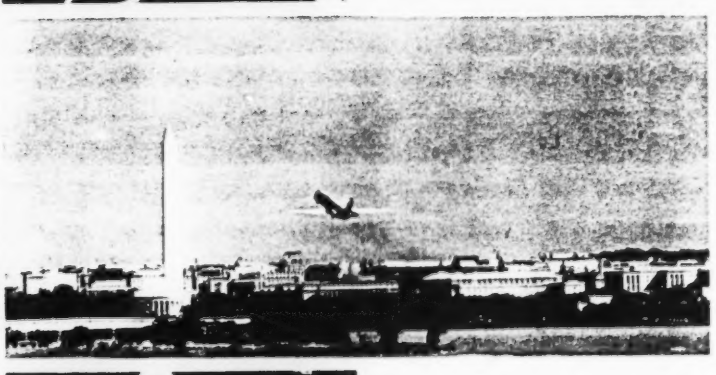
Much of the debate in recent years over the federal role in higher education has surrounded *appropriations*—federal dollars needed to assist colleges and universities to pursue their teaching, research, and public-service missions. But this ongoing debate should not obscure the revenue impact of federal tax policy on the nation's campuses. Various exemptions, exclusions, and other tax provisions have contributed to the development of U.S. higher education.

These considerations have ranged from the non-taxation of scholarships and fellowships to tax credits designed to spur scientific and technical research. The Tax Reform Act of 1986 altered some longstanding tax relationships—especially relationships aimed at encouraging private financial support for campuses, which many believe provide the "margin for excellence" at colleges and universities.

The tax reform movement in large measure was driven by a relentless search for new revenues to help trim the federal budget deficit and by a desire to close some well-abused tax loopholes. Laudable goals. Goals that higher education supports. But in pursuing these goals, lawmakers should avoid handicapping colleges and universities in the achievement of their teaching, research, and public-service missions—missions supported by the appropriations process.

In determining the contemporary relationship between the federal government and higher education, lawmakers and executives should consider a common sense political maxim advocated by Abraham Lincoln:

"The legitimate object of government is to do for the people what needs to be done, but which they cannot, by individual effort, do at all, or do so well, for themselves."



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American Higher Education: A Snapshot

More than 25 percent of Americans—65.3 million people—are students or are employed by schools and colleges, the U.S. Department of Education reports.

The United States in 1988 spent an estimated $307.6 billion on education, or about 7 percent of the Gross National Product (GNP). Federal, state, and local government invested $149 billion on education in 1986; state government was responsible for 49.4 percent of the investment followed by local government at 43.9 percent . . . and the federal government contributed 6.7 percent.

In 1986, about 74.7 percent of U.S. adults, age 25 or older, had earned high-school diplomas, while 19.4 percent had completed college.

Colleges and Universities

America's 3,406 campuses enrolled 12.5 million students—77 percent of whom attended public institutions—and employed about 700,000 faculty in 1987-88. These campuses—public and private, two-year and four-year colleges and universities—awarded in 1988 an estimated 424,000 associate degrees; 989,000 bachelor's degrees; 290,000 master's degrees; 33,500 doctorates, and 74,400 first-professional degrees. The number of degrees awarded by American campuses was nearly one-third greater in 1986 than in 1971.

About 7.1 million college students attended class full-time, while 5.4 million were part-time students in 1986-87. America's collegiate student body was 79.3 percent white, 8.6 percent black, 5 percent Hispanic, 3.6 percent Asian-Pacific Islander, 0.7 percent American Indian-Alaskan Native, and 2.8 percent non-resident alien. Campus enrollments included 5.9 million males and 6.6 million females.

U.S. campuses spent $124 billion in 1987-88, with the federal government contributing $10.1 billion to education programs, $9.7 billion for research, and $2.8 billion for other programs.

Seven funding sources in 1986-87 played key roles in financing colleges and universities: tuition, 23 percent; federal government, 12.6 percent; state government, 29.8 percent; local government, 2.5 percent; private sources, 5.4 percent; endowments, 2.3 percent, and sales-services/other revenues, 24.4 percent.

Private contributions to U.S. campuses climbed $1.1 billion in 1986-87, reaching a record $8.5 billion, according to estimates by the Council for Financial Aid to Education, Inc. (CFAE). The 14.9-percent boost over the previous year, CFAE notes, "was powered primarily by an exceptional rise in alumni giving." In 1986-87, alumni contributed $2.3 billion (27.6 percent); non-alumni, $2 billion (24.3 percent); corporations, $1.8 billion (21.4 percent); foundations, $1.5 billion (17.8 percent); religious organizations, $204 million (2.4 percent); others $552 million (6.5 percent). CFAE reports that 52 percent of private support is earmarked for current campus operations and 48 percent is targeted to capital purposes.

Average yearly tuition and fees, room and board charges at public campuses were estimated by the federal government at $3,875 in 1986-87, while these charges totaled $9,762 at private campuses.

"Between the academic years 1973-74 and 1983-84," the National Center for Education Statistics reports, "average charges for undergraduate tuition and fees, room, and board rose by 108 percent at public institutions of higher education and by 137 percent at private institutions. During the same period, the cost of living, as measured by the Bureau of Labor Statistics' Consumer Price Index, increased by 118 percent."

State and Land-Grant Universities

The 149 members of the National Association of State Universities and Land-Grant Colleges (NASULGC)—53 principal state universities, 72 land-grant campuses, and 24 system administration offices—enroll more than 2.6 million students; annually invest more than $33.6 billion in teaching, research, and public-service programs, and award about 468,000 degrees yearly, including 60 percent of all U.S. doctorates. NASULGC-member campuses claim about 14 million graduates.

These campuses have grown up with the United States. Some of them began as log cabins; others were established by territorial legislatures, years before statehood. Some of these institutions began their work in rented quarters, with a handful of students, and others even closed for a time as they coped with financial crises and the Civil War.

The University of Georgia was chartered as the nation's first state-supported university in 1785, when the United States still was governed loosely by the Articles of Confederation. The University of Pittsburgh was founded in 1787, the same year the founding fathers met in Philadelphia to draft the U.S. Constitution. The University of North Carolina was founded in 1789, when George Washington was president. In 1791, the University of Vermont was established—the same year Thomas Jefferson and James Madison stumped New York and New England, opposing the Federalist administration and launching the nation's two-party system. And, the University of Tennessee was founded in 1794—the same year Congress established the U.S. Navy, as fears mounted over the spreading revolution in France.

Education and Democracy

The Northwest Ordinance of 1787, which brought republican government to frontier territories, proclaimed that " . . . schools and the means of education shall be forever encouraged."

President George Washington asked Congress to consider the desirability of founding a national university, aiding "seminaries of learning" already established, or exploring some other expedient that would spur public interest in science and literature.

Thomas Jefferson—author of the Declaration of Independence, America's third president, and founder of the University of Virginia—in an 1806 congressional message urged grants of land as a way to endow a national university. His aim was to "develop the reasoning faculties of our youth, enlarge their minds, and cultivate their morals" and to "harmonize and promote the interests of agriculture, manufactures, and commerce . . . "

America in the early 19th century was on the move. Mines, railroads, canals, and a fledgling manufacturing sector were starting to give the United States an industrial patina. But the engineers and technicians guiding this development were coming from abroad. And, as eastern lands began to show telltale signs of wear and tear from abuse, farmers began eyeing virgin lands to the west.

American higher education increasingly was out of step with the times. Steeped in the European tradition of a classical education—and greatly restricted—it had no relation to the resources of the country or to the occupations and objectives of the people.

Morrill Land-Grant Act

An Illinois college professor, Jonathan Baldwin Turner, unveiled a "Plan for a State University for the Industrial Classes" in 1850. It called for using funds Illinois had received from U.S. government land sales to endow a state university.

Representative Justin S. Morrill of Vermont introduced a land-grant university measure in Congress in 1857. Lawmakers approved the legislation only to see it struck down by President John Buchanan's veto. The chief executive argued that the land-grant bill would cost too much; confuse the relationship between the states and the federal government; injure new

states by placing vast amounts of their lands into the hands of speculators; compete unfairly with established colleges and universities, and violate the U.S. Constitution since Congress was not empowered to appropriate money for education.

Morrill introduced another land-grant university law when the nation was bloodied by civil war. President Abraham Lincoln signed the first Morrill Land-Grant Act on July 2, 1862, awarding lands to the states for the establishment of colleges. The U.S. Senate had passed the measure in a 32-7 vote on June 11, while the U.S. House of Representatives approved the legislation June 19 by a 90-25 margin.

Under the Morrill Act, each state was to sell and use its allotment of federal lands for "the endowment, support, and maintenance of at least one college where the leading object shall be, without excluding other scientific and classical studies, and including military tactics, to teach such branches of learning as are related to agriculture and the mechanic arts, in such a manner as the legislatures of the states may respectively prescribe, in order *to promote the liberal and practical education of the industrial classes in the several pursuits and professions of life.*"

Campuses Take Shape

In some cases, states designated existing institutions land-grant campuses and reorganized them to include new departments of agriculture and engineering after passage of the Morrill Act. In other instances, new land-grant institutions were founded. And, some states opted to earmark land-grant responsibilites to private universities, such as Brown University in Rhode Island, Yale University in Connecticut, and Dartmouth College in New Hampshire.

Eight years after the Morrill Act went into the statute books, 37 states had agreed to accept and fulfill its provisions. Consequently, spurred in part by the Morrill Act, the four engineering schools the nation boasted in 1860 grew to 17 in 1870 and 85 by 1885—steady growth at a time when the United States was facing an Industrial Revolution that needed a strong engineering foundation.

The nation's new land-grant universities—and their emphasis on agriculture, engineering, and practical education—reflected the social and economic change going on as the nation settled and built a continent. By 1870, almost one-third of Americans worked in manufacturing, trades, and transportation.

By the closing years of the 19th century, it was clear that state and land-grant universities were changing people's lives. An editor of the University of North Dakota student newspaper commented in 1894:

"Many of us come here from the log cabin in the backwoods and the sod shanty on the frontier. And what do we come here for? To . . . rub off the corners and get rid of the greenness."

The Morrill Act symbolizes the "essential partnership" among state and land-grant universities' and the federal government, as well as a strong commitment to one of the institutions' three-fold missions: *teaching*. As part of this commitment, these campuses are credited with pioneering many new branches of study and widening access to higher education.

Research and the Hatch Act

Representative William Henry Hatch of Missouri, chairman of the U.S. House Agriculture Committee, spearheaded enactment of a measure in 1887 designed to help farmers prevent the continued destruction of their land from crude farming methods, while boosting farm productivity through the systematic application of science and technology to agriculture.

The Hatch Act mandated agricultural experiment stations "to aid in *acquiring and diffusing among the people of the United States useful and practical information* on subjects connected with agriculture and to *promote scientific investigation and experiment* respecting the principles and applications of agricultural science."

The legislation authorized $15,000 a year for the land-grant college in each state to carry out the Hatch Act's mission. Over the years, the Hatch Act has speeded development of a nationwide network of 56 experiment stations, employing more than 12,000 researchers whose investigations have helped give consumers the widest range of safe and nutritious foods at prices that are the envy of many other peoples.

The Hatch Act symbolizes a second dimension of the "essential partnership" among campuses and the federal government, as well as the commitment of campuses to conducting *scientific research* for the public welfare.

The Second Morrill Act

President Benjamin Harrison signed a second Morrill Act into law on August 30, 1890, following a bruising four-month Capitol Hill battle. The measure earmarked an additional endowment to the states and territories from public-land sales and an annual federal payment.

A key provision affected states which maintained separate colleges for white and black students. Those states were required to provide "a just and equitable division of the fund to be received under this act between one college for white students and one institution for colored students."

Consequently, the second Morrill Land-Grant Act inspired creation of historically black land-grant colleges in southern and border states. Today, 35 public black campuses—including 17 land-grant or "1890" institutions—enroll more than 130,000 students and graduate the lion's share blacks earning college degrees.

Smith-Lever Act

The Smith-Lever Act provides the third dimension of the "essential partnership" among state and land-grant campuses and the federal goverment, as well as illustrating the campus commitment to another great mission: *public service*.

Approved by Congress and signed into law by President Woodrow Wilson—a former professor and college president—in 1914, the Smith-Lever Act provided federal support for land-grant institutions to offer instruction beyond the boundaries of campuses, a function that already was being carried out by these institutions in the 19th century.

Iowa State University is credited with being the first agricultural college "to go to the farmers." Adonijah Welch, the campus' first president, in 1870 conceived the idea of having faculty conduct institutes in various parts of the state, making the university the birthplace of the modern Cooperative Extension Service. Welch and another professor conducted a series of off-campus farmers' institutes during the winter of 1870-71, the first programs of this type offered by a land-grant institution.

The Smith-Lever Act formalized this broadened view of the role of higher education, noting that the law's purpose was " . . . to aid in the diffusing among the people of the United States *useful and practical information on subjects relating to agriculture and home economics, and to encourage the applications of the same.*"

Returns on Investments

State and land-grant universities provide much of the human talent needed to run America's $4.4 trillion economy—the world's richest—and the new knowledge that spurs economic growth, sharpens U.S. trade competitiveness in markets abroad, and provides the technological know-how that undergirds national security.

Researchers at state and land-grant universities have discovered many of today's "wonder drugs": the pioneering antibiotics, Streptomycin and Neomycin; the blood-thinner Dicumarol; the antihistimine Benedryl; the cancer-fighter, Cisplatin, and the Salk and Sabin polio vaccines.

State and land-grant university scientists pioneered development of several artificial human organs, including the artificial heart; devised arteries made of synthetic materials that the human body would not reject; developed the heart pacemaker and the heart-lung machine; founded the first eyebank; invented the intrauterine device for contraception; synthesized the hormones Progesterone and Estrogen, launching the science of birth-control pharmaceuticals; developed Dermatome, a skin-grafting device; conducted trailblazing research that led to the discovery of various vitamins, and invented Nitrodur patches that release medicine in timed amounts to protect angina sufferers from heart attacks.

These institutions are home to the world's first atom smasher, digital computer, and America's first globe-girdling satellite, *Explorer I*. State and land-grant campuses played leading roles in the development of television, the transistor, radar, steel-frame skyscrapers, the concrete used in turnpikes, sound-on-film motion pictures, a new generation of super-fast computer chips—and to every motorist's sorrow, the parking meter.

Researchers at state and land-grant campuses had a big hand in developing some widely used consumer products, such as the thirst-quenching soft drink *Gatorade* and cavity-fighting *Crest* toothpaste.

In agriculture, campus-based research applied by America's farmers has helped make the United States the world's breadbasket. This research has led to development of hybrid corn; countless new strains of fruits, vegetables, wheat, and barley; artificial insemination techniques for cattle; numerous vaccines that protect cattle, poultry, swine, and other livestock from a long list of illnesses, and new genetic engineering techniques, which are making America's crops and livestock more resistant to disease, more nutritious, and more flavorful.

The work of state and land-grant universities has changed U.S. laws. A chemist's efforts to organize the first National Pure Food Congress in the 1890's led to the federal Pure Food and Drug Act of 1906. An agricultural economist from a state and land-grant campus was tapped by President Franklin Roosevelt to develop the New Deal's farm program, resulting in the Agricultural Adjustment Administration. A commission headed by a campus-based economist drafted the landmark Social Security Act of 1935. The discovery by two researchers that propellants in aerosol spray cans was damaging the Earth's fragile ozone layer, protecting the planet from radiation, resulted in the banning of chlorofluorocarbons.

Alumni

Alumni of state and land-grant universities have assumed leadership positions throughout U.S. society—and the world.

Roughly half the members of Congress attended state and land-grant universities, as well as about half of the nation's 50 governors. *Fortune* magazine's annual listing of the nation's 500 leading corporations reveals that more than half of the presidents and board chairmen of these businesses attended state and land-grant universities. And, more than 100 faculty and alumni of state and land-grant campuses have been recognized globally for their professional achievements—particularly in science—by being named Nobel laureates.

Many state and land-grant university alumni are "stars" in their professions: U.S. presidents, Cabinet secretaries, members of Congress, and diplomats; movie stars and professional ath-

letes; astronauts and leaders of billion-dollar corporations; artists and musicians; scientists and engineers; teachers and educators; writers and journalists, and lawyers and doctors of national and international acclaim.

But, equally compelling are the stories of less well-known individuals, who have left indelible marks on society. A medical doctor, who for years, ran a 15-bed hospital in the Rio Grande Valley, aiding those living in poverty. The teacher who began with $10 a California school for youngsters of Depression-era drifters. The professor of science who gave students jobs in her snack shop so they could earn money to go to school. And, the Italian immigrant, who came to America in 1914, and spent $5.63 a month commuting to college. He became an internationally respected orthopaedic surgeon and "repaid" his alma mater by administering to its athletes for 40 years without pay.

A newspaper editor, who came from a poor family and flunked out of high school, got a second chance at a state and land-grant university. "Among all the nation's of the world," he wrote, "the United States leads in providing a system of state universities and land-grant colleges that provide hope, opportunity, and education for the many. [It] is one reason I am grateful I was born in this nation."

Education & The Economy

"If every child who reaches the age of 17 between now and the year 2000 could read sophisticated materials, write clearly, speak articulately, and solve complex problems requiring algebra and statistics, the American economy could easily approach or exceed . . . 4 percent growth . . . Unconstrained by shortages of competent, well-educated workers, American industry would be able to expand and develop as rapidly as world markets would allow."

That's the conclusion of a U.S. Labor Department study illustrating just how intimately America's economic security is tied to its educational prowess.

State government agrees.

A Task Force on Education and Economic Growth of the Education Commission of the States declared: "It is our conviction that economic growth is essential. *And it is our judgement that a high general level of education is perhaps the most important key to economic growth.*"

What is clear to federal and state government also is clear to no-nonsense bottom-line managers in America's great corporations.

Ford Motor Co. chief Donald Peterson said: "Today's successful corporations act on the understanding that people are the real resource of any enterprise and that people have to be given every chance to hone their abilities and sharpen their skills. *Jobs of the future will require more skilled workers and technicians, more scientists and engineers . . .*"

Yet, Congress' Joint Economic Committee (JEC) listened to a parade of 52 witnesses from September-December, 1987—witnesses who told the lawmakers that the national high-school dropout rate is 25 percent, and that it skyrockets to 40 percent for blacks and to more than 50 percent for Hispanics. And, Rhode Island Governor Edward D. DiPrete noted that functional illiteracy robs the U.S. economy of $25 billion each year in lost productivity, accidents, damage to equipment, and government support programs.

New Workforce Realities

By the year 2000, the U.S. population will reach an estimated 275 million, a 15-percent increase compared to 1985, according to the U.S. Labor Department. Between 1985 and 2000, the U.S. labor force will grow by about 22 percent, from 115 million to 141 million. Forecasters predict that at the turn of the century the nation's workforce will be older, more female, and populated by greater numbers of minorities and immigrants.

The federal government predicts that this labor force will face an economy calling for fewer low-skill jobs and "overall, the skill mix of the economy will be moving rapidly upscale, with most new jobs demanding more education and higher levels of language, math, and reasoning skills. These occupational changes will present a difficult challenge for the disadvantaged, particularly for black men and Hispanics, who are underrepresented in the fastest growing professions and overrepresented in the shrinking job categories," according to the U.S. Labor Department's study, *Workforce 2000*.

The Labor Department anticipates an average gain of about 25 percent across all occupational categories, but the fastest-growing fields—lawyers, scientists, and health professionals—are expected to grow two or three times as quickly. These trends are reflected in an ongoing structural shift in the U.S. economy—a shift away from manufacturing and toward service industries.

The U.S. Bureau of Labor Statistics reported in August, 1988, that one of every four U.S. workers is a college graduate, compared with one in every five workers a decade ago. Another

20 percent of the U.S. workforce, the bureau noted, has completed one to three years of college—up from 16 percent 10 years ago. The proportion of workers without a high-school diploma has dropped from 24 percent in 1978 to 15 percent.

This trend is likely to continue. The federal government forecasts that 22 percent of the new jobs created by the turn of the century will require one to three years of college, while another 30 percent of those new jobs will demand four years of college—or more.

Competitive Edge Dulled

The United States is under attack.

But no foreign soldiers are charging America's coastline. The battlefield, instead, is in factories and laboratories and on assembly lines and in farm fields—the global marketplace.

Rifles and rockets, the weapons of military warfare, have been replaced by computers, cars, corn, and classrooms—the weapons of economic competition.

America—the arsenal of democracy in World War II and the economic powerhouse of the 1950's and 1960's which rebuilt the war's vanquished—is hearing footsteps.

"The United States," says John Young, president and chief executive officer of the Hewlett-Packard Co. and chairman of the Council on Competitiveness, "is losing its competitive edge, threatening this nation's future wealth and prosperity."

The United States imported a record $171 billion more than it exported in 1987, according to the congressional Joint Economic Committee (JEC). Seven years earlier, the U.S. trade ledger was essentially in balance.

In 1981, the JEC reports, U.S. assets held abroad were officially estimated at $140 billion more than the value of assets held by foreigners in the United States. Yet, mid-1988 U.S. indebtedness to foreign creditors stood at $440 billion and was climbing.

" . . . our nation is struggling under worldwide competition for economic development," says William S. Lee, chairman and chief executive officer of Duke Power Co. *"The quality of education will determine the winner.* Not minerals, not climate, not water or land, not markets or transportation, not energy, not even wages—although some of these things may be important as tie breakers—but, rather, education."

Lee adds: "Our economic future is only as bright as our young people, and we must recognize *quality of education as our highest priority in economic development."*

Education & Competitiveness

Competitiveness is a buzzword in Washington. Upwards of 5,000 "competitiveness bills" were introduced on Capitol Hill in 1986—*before* the issue became a lightning rod—and more than one-third of Congress had joined the Competitiveness Caucus by 1987.

A 1986 White House report on the "health" of U.S. campuses noted: "Over a century ago, the nation's dependence upon the agricultural economy stimulated establishment of the land-grant colleges, whose research and training helped make American farmers the most productive on Earth.

"Today," the report added, "we depend on technology for our competitive edge in virtually every area of our economy. Our investments in university education and research, and thus in new scientific knowledge and talent, are therefore even more important."

If the United States is to remain a key player in the global economy, it must invest in education—education that will fuel the research and innovation needed to develop new products and technologies that will spark U.S. economic productivity.

Since 1972, the Council on Competitiveness reports, Japan's manufacturing productivity has increased eight times faster than America's; West Germany's, three times faster, and America's seven major industrialized trading partners, on average, four times.

Trouble Spots

But despite widespread understanding of the powerful links among education, research, productivity, and economic competitiveness, the United States is grappling with some serious "human capital" and related trouble spots:

✔ ***Basic Educational Skills.*** The congressional Joint Economic Committee (JEC), citing a national assessment of educational performance, reports that only 11 percent of high-school students can properly read a bus schedule, 10 percent can compute the cost of a meal from a menu or find information in a news article.

"Basic education," a witness told the JEC, "will educate [students] very well to sign their unemployment checks and it will provide them a way to go collect in the welfare lines. It will not give them the kind of job that they need to have if we are to compete internationally in the high tech world that we are going to face in the future."

✔ ***Scientist-Engineer Shortages.*** U.S. schools are failing to produce the number of scientists and engineers the economy is likely to gobble up by early in the 21st century. With fewer students in the general pipeline, and fewer high-school graduates opting for science and engineering careers, the Council on Competitiveness reports that "a shortfall of more than 500,000 scientists and engineers is projected by the year 2010."

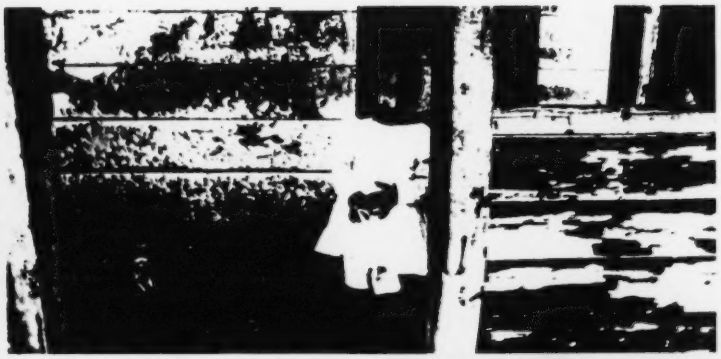
Studies indicate that many students select themselves out of science and engineering tracks as early as grades five through eight. Consequently, only 8 percent of all bachelor's-degree graduates in 1985 earned their diplomas in engineering. This decline is expected in many quarters to continue and accelerate.

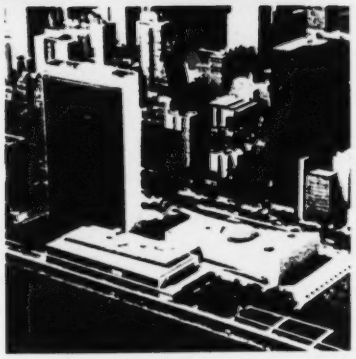
✔ ***Minority Outreach.*** "If the United States is to train adequate numbers of scientists and engineers in the future," the Council on Competitiveness urges, "it will have to reach out to . . . traditionally underrepresented groups [women and minorities]. In the year 2000, these groups will account for about 85 percent of new entrants into the nation's work force. Their involvement in science and engineering is essential to the nation's future strength in technology."

If that's the case, the nation's future technological prowess may be mortgaged. In 1986, 24 blacks earned engineering doctorates out of the 3,376 diplomas conferred, and blacks received only 33 of 4,408 doctorates awarded in the physical sciences, according to the Coalition for National Science Funding (CNSF).

✔ ***Teacher-Faculty Shortfalls.*** Shortages also are predicted for competent math, science, and engineering faculty. The National Science Foundation rates 60,000 math-science teachers in U.S. high schools "not fully qualified" and by 1995 the United States will require an estimated 300,000 more math-science teachers at the secondary-school level.

A 1985 study by the American Society for Engineering Education revealed an 8.8 percent faculty vacancy rate—and that more than half of the campus slots that were vacant in 1985 were unfilled in 1984.





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Higher Education & America's Future

The philosopher Aristotle cautioned that "All who have meditated on the art of governing mankind have been convinced that the fate of empires depends on the education of youth."

Aristotle's ancient observation should serve as a cogent guide to Americans, eyeing the 21st century.

As policymakers at all levels of government survey the political, social, and international landscape facing the United States, a dominating feature on that landscape is education.

Education plays a pivotal role in seven critical areas that the United States is grappling with on the eve of the year 2000: agriculture and food . . . cities . . . environment and natural resources . . . international relations . . . investments in people . . . minorities . . . scientific and technological research.

As lawmakers and public officials wrestle with the seemingly chronic and intractable problems—costly problems—littering the nation's political, social, and international landscape, they are encouraged to tap the resources of America's great state and land-grant universities in the search for solutions.

. . . Agriculture & Food

Agriculture is the foundation of America's economy.

Over three centuries, America's fledgling farm economy of colonial times has grown to the largest single sector of a $4.4 trillion economy. U.S. agriculture, the world's largest industry, has assets valued at $1 trillion and employs 21 million workers—18.5 percent of America's workforce. Farm products—the nation's leading export—earned the United States $28 billion in fiscal 1987, while generating more than one million jobs mostly in non-farm industries.

Productivity—the ability of the few to feed the many—is the trademark of American agriculture. In 1940, the U.S. Department of Agriculture (USDA) reports there were 6.35 million farms and each farmer, on average, produced food and fiber for 18.5 people; now with 2.17 million farms each farmer, on average, produces enough food and fiber for 112 people.

America's plentiful harvests also give consumers a wide range of quality foods at low relative cost. By the mid-1980's the average American family reached into its wallet for only 15 percent of its disposable income to put food on the table—a record low. In some nations, upwards of 60 percent-70 percent of disposable income is earmarked for purchasing food.

Keys to Productivity

Education and research, primarily conducted at land-grant universities, play pivotal roles in America's farm productivity—an economic achievement envied and respected worldwide.

USDA points out that "one of agriculture's best kept secrets is that agricultural research programs that lower production costs to farmers primarily benefit U.S. consumers by bringing about lower prices."

Since the 1950's, USDA observes, numerous cost-benefit studies of agricultural research have been conducted. "The resulting benefit/cost ratios vary greatly," the department observes, "but most fall in the range of $30 to $50 of benefits for each dollar spent."

Yet, these benefits are threatened by a future lack of professionals. Former President Ronald Reagan's science advisor, William R. Graham, says: ". . . there has been a tremendous drop (more than 30 percent) nationwide in the enrollment of students in agricultural and natural resource programs in colleges and universities. This means that fewer agriculturally trained researchers and teachers will be available in the future. We must halt this decline in enrollment."

Changing Scene

Although America's farms and food-related industries are the nation's leading source of renewable wealth, serious problems persist on the land.

Fertilizers, pesticides, antibiotics, and other substances have boosted farm production, but they also have triggered worries about water quality and food safety. America's eating habits are changing, as more links are discovered between nutrition and health. And, the economics of family farming—made tougher by recent killer droughts—present new challenges and opportunities for agricultural innovation.

Consequently, an initiative is needed that will make a national investment to help spark the profitability of U.S. agriculture by creating new and diversified uses and markets for farm and forest products; improving diet and nutrition and the health of Americans, and contributing to safeguarding the environment by more prudently using natural resources.

Call To Action

Therefore, state and land-grant campuses are calling on Congress to fund a National Initiative for Agricultural Research.

The broad outlines of the initiative—supported by farm and commodity groups, agri-business, professional and scientific societies, higher-education organizations, and others—include:

✔ Annual funding would be at about $500 million and would not necessarily be limited to U.S. Department of Agriculture support.

✔ Competitive grants would be awarded, emphasizing the quality and relevance of scientific research.

✔ Land-grant, as well as other, campuses would be eligible to receive research grants; federal and corporate laboratories also could participate in the program.

✔ Research would be targeted to sciences basic to food and agriculture—sciences that address growing environmental concerns. Additional research focuses would include enhancement of product quality, safety, utility, and value; fewer resources would be earmarked for research aimed at hiking food and fiber production.

The initiative is not envisioned as a substitute for any current funding or programs. It is designed to concentrate on cutting-edge technologies; existing funds focus on continuing agricultural problems and priorities.

Recommendation

Legislative and executive policies should view agriculture in its broadest context—a life-science industry that undergirds the American economy and plays a positive and pivotal role in American foreign-trade.

Consequently, enactment of the National Initiative for Agricultural Research is urged to help spur efforts to bolster America's domestic economy, international-trade competitiveness, and the wholesomeness of the nation's health and environment.

Additionally, existing research, education, and public-service programs should be expanded so that the nation can be assured of a new generation of talented agricultural professionals and that America's farm communities can remain profitable and better cope with the challenges of contemporary life.

. . . Cities

U.S. cities—where the bulk of Americans live—are studies in contradictions. Some of their neighborhoods are cesspools of poverty, at times likened to rubble-strewn Berlin at the end of World War II. Other communities are vibrant—centers of business and culture—that have regained their past luster through prudent investment in downtown renovation, wise public policy, and community pride.

"The 1980's have been a time of neglect for national urban policy," observes a 1989 NASULGC report, *America's People: An Imperiled Resource*. "After years of significant federal investment in the nation's cities and urban institutions, the United States has witnessed a weakening of national resolve to find solutions to the problems of urban citizens.

" . . . central cities are becoming depositories, by default, of the least advantaged—with these [people] often living in desperate pockets of poverty.

"State and local governments," the report adds, "always will have a critical role to play in urban policy, but urban problems are increasingly national in scope and effect . . . national urban policy . . . should be a central priority for a new national administration."

Among the major challenges facing the nation's cities, NASULGC's Division of Urban Affairs has pinpointed six particular issues: economic development, environmental protection, housing, poverty, health, and education.

The nation's urban universities are concerned about these issues because many institutions are located in central cities or are affected by deteriorating inner-city society. These campuses draw the vast majority of their students from cities, and they serve urban neighborhoods with a wide array of public-service programs, ranging from hospitals to legal assistance.

Economic Development

The nation's economic growth spurt during the past eight years is threatening to sidestep some urban areas in the long-term. The reasons are many: a future labor shortage centering on a large pool of inner-city youth who have failed to master basic reading, writing, and math skills; crumbling highways, bridges, water and sewer systems, solid-waste disposal facilities, and other infrastructure; development of a prosperous bicoastal economy with pockets of blight in America's heartland; changing capital-market structures that might make it difficult for minority-owned and small businesses to obtain financing; growing gaps in the quality and scope of telecommunications services available in different cities in the aftermath of federal deregulation, and bidding wars for prestigious economic-development projects that could leave some cities with debts that may become unmanageable.

The Environment

After decades of public-health progress, America's cities again are trying to cope with a host of environmental issues largely stemming from fallout from toxic materials and processes needed to fuel economic growth.

Urban sewer systems are badly in need of physical and managerial upgrades. Air pollution remains a chronic problem in some cities despite remedial efforts. In many places water quality and supplies continue to be troublesome problems. And, fewer locations are being found to accept the refuse of contemporary society—solid, toxic, and hazardous wastes—as the NIMBY Syndrome (Not in My Back Yard) becomes more commonplace.

Maintaining and improving healthy air and water is costly. The federal Council on Environmental Quality estimates that $271.6 billion was spent between 1972-79 by government and business on pollution abatement; an additional $518.5 billion would be spent by 1988.

Cities are facing increased costs to comply with stricter environmental rules and laws, while environmental-control technologies fail to keep pace with pollutants.

Housing

In virtually all U.S. cities there is a lack of affordable housing—especially for renters.

The *American Housing Survey* found that the number of "inadequate structures" in metropolitan areas increased by 10 percent from 1974 to 1981; the number of "inadequate neighborhoods" climbed by one-fourth.

The NASULGC report noted that "for certain groups, such as minorities, the situation was worse; as of 1981, households headed by blacks were twice as likely as their white counterparts to live in structurally inadequate buildings or neighborhoods . . .

"From 1974 to 1981, the number of renter households paying more than 35 percent of their income for housing rose from 5.8 million to 9.1 million . . . this included more than six-million households earning less than $5,000 in 1980." The increase in homelessness, during the 1980's, now estimated at 250,000 to three million, is the most graphic and tragic testimony to a lack of affordable housing."

Poverty

As well-paying manufacturing jobs, with generous fringe benefits, have been more frequently replaced by less lucrative jobs in the nation's burgeoning service industries, the borderline poor have emerged as the full-time working poor. The percentage of working poor is the highest since 1968, 41.5 percent of those age 15 or older in 1987, the NASULGC report says, noting that 8.9 million Americans in 1986 earned incomes that were insufficient to pull themselves and their families out of poverty.

These trends have come at a time when ballooning federal deficits and budget-balancing legislation have shredded portions of the social "safety net". Additionally, plant closings have left entire communities in economic and social shock as community pillars have vanished, such as a 75-year old auto assembly-line in Kenosha, Wis.

U.S. Census Bureau figures for 1986 reported that 13.6 percent of the U.S. population had incomes below $11,203, the official poverty line. In 1986, families headed by women—for the first time—accounted for more than half of all poor families and totaled 3.6 million families. A disturbing 22 percent of youngsters under age six lived in poverty, and most were minorities: 45.6 percent, black; 40.7 percent Hispanic.

Poverty is taking a toll on America's youngsters—America's future. U.S. infants die at a rate exceeding that of 18 countries, and in several cities the infant mortality rate is twice the national average, while the infant-mortality rate for blacks is almost double that of other groups. Moreover, one in four U.S. children are born in poverty; more than one in five will grow up in poverty.

"Further," the NASULGC report says, "there is increasing evidence that once households and individuals drop below the poverty line, they stay there for a long time. A recent study finds that one-third of the urban poor in 1979 were poor in at least eight of the 10 years from 1974-83."

Education

An overwhelming number of disadvantaged youngsters living in central cities will not receive the education needed to enter the mainstream of American life—and, most of these children are from minority groups. In Boston, 70 percent of the school population is black or Hispanic; a majority come from families on welfare and living in public housing.

In educational attainment, *America's People: An Imperiled Resource* points out, "urban black and Hispanic students are less likely to achieve in school, less likely to complete high school, and less likely to go to college than their peers."

Against this stark backdrop, federal aid to the nation's largest school districts—adjusted for inflation—plummeted 20 percent from 1980-81 to 1985-86.

Urban school districts, the NASULGC study observes, face various financial problems resulting from a concentration of students with special needs—students who receive little encouragement from their families to excel in the classroom.

Health Care

Health and medical costs consume 11 percent of the U.S. Gross National Product (GNP). Two decades ago, this slice of the U.S. economy totaled 5.8 percent. Federal forecasts estimate that health and medical care may account for 15 percent of the GNP by the turn of the century.

The elderly—leading consumers of health and medical care—make up 13 percent of the U.S. population, but over the next four decades will increase to one-fifth of all Americans as the post-World War II "baby boomers" move into their "golden years". This demographic time bomb will place great strain on the nation's hospitals, nursing homes, and health-care system, as well as Medicare and other federal programs.

Recommendation

As government at all levels grapples with the wide array of social, economic, scientific, medical, and other problems plaguing America's great cities, authorities should be mindful of the wide range of resources, expertise, and goodwill found in the nation's urban campuses—and search for imaginative ways to put universities to work improving the quality of life in the metropolitan communities.

Congress should continue to expand its commitment to urban campuses reflected in Title XI of the Higher Education Amendments of 1986—Partnerships for Economic Development and Urban Community Service. This legislation authorizes federal support to identify and disseminate effective partnership models for educational institutions and other agencies involved in area or regional economic development, and extends support for collaborative problem-solving by urban universities and city governments.

. . . Environment & Natural Resources

August 1, 1988. *Time* magazine's cover story was headlined: "Our Filthy Seas"; *Newsweek's* cover cautioned: "Our Polluted Oceans: Don't Go Near the Water".

The nation's two leading news magazines chose the same week to hammer home to millions of readers the blunt warning that a major portion of the environment was fouled.

And, *Time* magazine chose the Endangered Earth as the "Planet of the Year" for 1989 instead of its traditional Man or Woman of the Year, spotlighting the notion that the Earth is vulnerable to man's reckless ways.

A killer drought . . . soaring summer temperatures . . . acid rain . . . contaminated groundwater . . . medical refuse washing up on America's beaches . . . concern that the Earth's fragile ozone layer, shielding it from harmful radiation, is damaged . . . a garbage barge sailing aimlessly for weeks seeking a port for its unsavory cargo . . . fear of the so-called "greenhouse effect", the warming of the Earth, as forests are chopped down and more carbon dioxide is pumped into the air that plants, animals, and, people breathe . . . These are some of the complicated environmental issues that have captured the nation's attention.

Key Federal Legislation

But just as greater environmental challenges are faced, science and technology are beginning to develop tools to better understand and manage global change. Among those tools are computers, remote sensors, robotics, and Earth-orbiting satellites. And, as environmental change—human activity or natural phenomena—is better understood, the nation will benefit in terms of economic competitiveness and security.

Three key pieces of federal legislation, of interest to U.S. campuses, help to shield and conserve the environment: State Mining and Mineral Resources Research Institutes Program, Water Resources Research Act, and the Renewable Resources Extension Act.

Under the State Mining and Mineral Resources Research Institutes Program, facilities at public colleges and universities conduct basic and practical research and provide training for mineral engineers and scientists. Federal funding also is provided to support demonstration projects—some of which are regional and involve two or more institutes.

The Water Resources Research Act authorizes an ongoing program of water quality and quantity management, reflecting a commitment to this vital resource at the federal, state, and local-government levels. The legislation promotes development of water-resources scientists, engineers, and technicians. Under the act, the secretary of the interior approved establishment of one water resources research and technology institute center in each state at an 1862 Morrill Act campus. Matching grants for basic research on a broad range of water-related problems also can be awarded under the legislation.

The Renewable Resources Extension Act provides for education programs affecting forest and range-based outdoor recreation, trees and forests in urban areas, and trees and shrubs in shelterbelts; the dissemination of research results; education programs to aid in technology transfer for managing and protecting forests and rangelands; development of education programs tailored to the needs of small, private, non-industrial forest landowners; education programs dealing with range, fish, and wildlife management; continuing education programs for professionals, and other programs.

Global Change

Just as the world is awakening to the fact that nation's are linked in a global economy, it also is discovering that the Earth's oceans—70 percent of the planet's surface—and atmosphere are intimately bound together in a relentless cycle of global change.

NASULGC-member campuses and their graduates are at the forefront in marine and atmospheric sciences. Computer scientists now have the machinery needed to tackle global scale modelling. Social scientists are equipped to analyze the human dimensions of global change. An enhanced and sustained partnership among universities and the federal government is critical in moving towards an increased understanding of global change.

The nation's state and land-grant universities have special responsibilities and opportunities with respect to global change. Data needs to be amassed, environmental monitoring must continue, and the need to better understand the dynamics and repercussions of global change are major challenges that may help hone the ability to predict natural disasters and phenomena. Consequently, NASULGC was encouraged by the release of *Our Changing Planet: A U.S. Strategy for Global Change Research*, which accompanied the president's fiscal 1990 federal budget request.

Recommendation

Congress and public officials at all levels of government should continue to support environmental research and education programs designed to give the United States a better understanding of the intricacies of the delicate ecological balance that sustains life on planet Earth, while providing the United States with the skilled professionals needed to wisely manage and conserve the America's bountiful natural resources.

Congress should increase federal funding for marine research and technical assistance, develop fully the government-industry-university partnership in marine affairs, fully support new initiatives in satellite oceanography and marine biotechnology, and develop a national ocean policy and marine-resource strategy to promote economic development, enhance wise use of natural resources, and more easily resolve conflicts—international and domestic—arising from environmental issues.

. . . International Relations

The world is an increasingly small . . . crowded . . . dangerous . . . and interdependent place—a "grand oasis in the big, vastness of space," as described by an astronaut speeding toward the moon.

In a world filled with revolution and terrorism, nuclear-tipped rockets and massive armies, hunger and poverty—understanding and improved relations among nations are critical to maintaining world peace, promoting economic growth, and spurring global progress.

State and land-grant universities for more than a century have been working beyond America's shores, bringing teaching, research, and public-service programs to other nations. In 1949, these campuses answered President Harry Truman's call to put science and industry to work "for the improvement and growth of underdeveloped areas," with the chief executive commenting: "I appreciate fully that in these institutions is a reservoir of talent and I heartily appreciate your pledge of full cooperation . . . "

Four Priorities

Consequently, four priority areas of continued collaboration among state and land-grant universities and the federal government are deemed critical for the 101st Congress and the Bush administration:

✔ ***International Education***. A new system should be fashioned to spur the growth of much stronger international dimensions in higher education. The world beyond America's shores will infect the careers of college graduates in engineering, science, teaching, business, medicine, journalism, and many other professions. The United States also requires increasing numbers of highly trained foreign language and international specialists to bolster the U.S. position in foreign trade and finance.

Therefore, federal authorities should consider creation of a new National Endowment—perhaps jointly funded by state and federal sources—to help the United States better meet its international business and government obligations in the years ahead.

✔ ***International Exchanges.*** It is in the national interest to build a federal support system—beyond those existing—that eases and encourages educational exchanges across international borders. Exchanges contribute to improving educational and research programs, while serving to build global professional networks that can be tapped to deal with specific problems and crises.

✔ ***Cooperation & Development.*** Experience over decades illustrates the wisdom of fashioning international cooperation programs in the Third World that rely less on aid relationships and more on long-term development efforts.

State and land-grant universities urge Congress and the Bush administration to target priority attention to ending food shortages and hunger in developing nations and evolve a strategy stressing sustainability in agriculture, food security, stronger agricultural education, and research institutions and policies which encourage greater production. Africa should receive special attention.

✔ ***Global Problems.*** Universities are well-positioned to conduct research on issues of international significance—research, for example, on global environmental trends, conflict management and the search for peace, and aspects of economic and social development.

U.S. experience with bilateral-development assistance has netted four key lessons: agriculture is the dominant economic sector in most developing nations; agriculture can serve as a catalyst to general economic growth; specific conditions must be nurtured to sustain agricultural development, and the United States has a comparative advantage in creating those conditions.

Bilateral Development Assistance

U.S. bilateral development assistance programs must be sharply focused and directed squarely at fundamental bases of poverty abroad. U.S. assistance must stress programs with high payoffs in terms of economic development and growth.

Therefore, state and land-grant universities are urging specific revisions to the U.S. Foreign Assistance Act that reaffirm America's resolve to help spur economic development and back up that commitment with adequate budgetary and human resources sustained over a sufficiently long time period to yield results. Specifically, the legislation must make clear that the United States will place top priority on the modernization of developing-country agriculture. Investments should be limited to creating or strengthening:

✔ Indigenous institutions of higher education in agriculture and related sciences.

✔ National agricultural research institutions to provide a continuous stream of innovative technology, information, and knowledge.

✔ Institutional capacity to transfer improved technologies to farm workers and others.

✔ Indigenous institutions committed to providing adequate incentives to assure sustained agricultural growth and equitable and accelerated general economic growth.

The U.S. Foreign Assistance Act also should mandate adequate investments in people through advanced education of developing-country scientists in the United States and elsewhere.

Debt For Development

When Carlos Salinas de Gortari was inaugurated as Mexico's new president in December, 1988—after winning a disputed election with a razor-thin victory margin—he sent a blunt message to his country's creditors: "The priority will no longer be to pay, but to return to growth."

The 40-year old U.S.-educated economist called the current level of payments on Mexico's $106 billion foreign debt "unacceptable and unsustainable," noting that economic growth is impossible unless Mexico stops earmarking about 5 percent of its Gross National Product (GNP)—about $9 billion—to cover interest payments on its foreign debt. Mexico's huge foreign debt is credited with contributing to a 20-percent to 40-percent fall in the living standard for the country's 83 million people.

Latin American debts to other nations, bankers, and creditors was pegged at $410 billion in 1988, while Third World nations' debt crossed the $1 trillion threshold in 1986.

An innovative concept—debt for development—which gained momentum in 1988, under state and land-grant university leadership, may help debtor nations get back on the road toward economic growth and security.

The debt for development approach generally offers four ways to utilize foreign debt to spark economic-development programs—such as education, public health, nutrition, agriculture, small business development, research, housing, and natural-resource management—in Asia, Africa, Latin America, and the Pacific Basin:

✔ Not-for-profit groups can purchase developing-country debts in secondary financial markets and convert them into local currencies.

✔ Commerical banks and others can donate debts as charitable contributions to not-for-profit organizations under a U.S. Internal Revenue Service ruling.

✔ Debt for development programs can be crafted as important components in rescheduling debt plans by creditor nations.

✔ Private institutions can convert their debt into equity positions—including joint ventures—if suitable investment opportunities can be pinpointed.

A Debt for Development Coalition was incorporated in 1988. Coalition members include U.S. colleges and universities, cooperatives, private voluntary development organizations, and research institutes engaged in economic-development programs abroad.

Recommendation

In a world profoundly dominated by a global economy and a seemingly elusive search for peace, the United States should increasingly recognize that its colleges and universities are constructive instruments of diplomacy—instruments that serve the long and short-term objectives of U.S. foreign policy.

Expanded resources should be channeled to these campuses and invested in foreign language and area study programs, scholarly exchanges, technical assistance programs, social science and scientific research efforts, and public-service programs. U.S. efforts should be guided by the need to sensitize succeeding generations of American professionals to the realities of the global marketplace, as well assisting others in nation-building efforts.

. . . Investing in People

U.S. Education Secretary Lauro Cavazos has challenged the United States to educate every child to his or her fullest potential.

"Too many of our young people—especially black and Hispanic students" Cavazos says, "suffer an education deficit, and, as a result, their ability to compete will be seriously impaired. We must begin now to prepare our children for the challenges of the 21st century. Let them look back . . . and find that we had courage and the conviction, that we made an investment in their future—and ours."

U.S. history is largely a tale of a government investing in the potential—future achievements—of its people. The democratization of higher education—promoted by the passage of the 1862 and 1890 Morrill Acts and the G.I. Bill during World War II—has been enhanced over the years by the creation of federal grant, loan, and work-study programs aimed at helping students of ability meet their educational costs.

$24.5 Billion Investment

Federal and state government, as well as college campuses, invested $24.5 billion in student-aid programs in 1987-88, according to The College Board. U.S. government programs accounted for three-quarters of all student-aid dollars, while institutions are credited with providing 19 percent of this support and states contributed 6 percent of the total.

The Guaranteed Student Loan (GSL) and related programs are the largest source of financial aid, totalling $11.3 billion or 46 percent of the student-aid dollar pool. Over the years, loans valued at $40 billion have been made, according to the U.S. Department of Education, which points out that more than 7,000 campuses, 13,000 lenders, and 54 loan-guarantee agencies participate in the program.

Since 1972, 32 million college students have received more than $30 billion in financial assistance under the Pell Grant program, the federal government's basic student-aid program. Nearly three million students receive these grants annually—about half of them come from families with incomes under $7,500; almost three-quarters of these students hail from families where yearly earnings are under $15,000; and about one-third of Pell Grants go to blacks, Hispanics, and American Indians. Yet, in recent years, the value of Pell Grants has declined from covering about half the cost of attending college to about 26 percent of such costs.

The College Board observes: "For federal campus-based programs (Supplemental Educational Opportunity Grants, College Work-Study, and Perkins Loans), inflation-adjusted dollar support declined 17 percent in the 1980's. The numbers of recipients decreased in the first two programs, and all three programs show declining average awards in constant dollars."

Disturbing Trend

While student-aid programs have broadened access and opportunity to higher education, some observers are increasingly worried about the growing reliance on loan programs, rather than grants, and the implications of this trend in terms of accumulated debt by students.

In the mid-1970's, the College Board reports, grants accounted for 80 percent of all student aid, but declined to 56 percent by 1980-81 and 47 percent in 1987-88. Consequently, the proportion of student aid credited to loans grew from less than one-fifth to more than half of all available student assistance.

The College Board concludes that "with the federal effort in student aid eroding during the 1980's, the purchasing power of total aid from all sources has increased little more than inflation. Thus, three adverse trends—rapidly escalating college charges, lagging family incomes, and slow growth in student aid—have made financing postsecondary education, on average, more difficult during the 1980's."

Loan Defaults

Not surprisingly, as loans have come to play a larger role in the mix of student financial-aid programs, defaults have become more commonplace.

The U.S. Education Department reported in 1988 that the loan-default rate had climbed 200 percent during the last five years and cost taxpayers $1.5 billion in fiscal 1989. The department also says that of the $12 billion in GSLs outstanding, $5 billion is overdue. But, enhanced collection efforts in 1988 contributed to collecting about $22.2 million in outstanding loans.

Education Secretary Cavazos has canvassed Congress, campuses, students, lenders, loan-guarantee agencies, and others for advice on how to stem the loan-default problem. By early 1989, the U.S. Education Department had received more than 1,200 suggestions for curbing loan defaults.

Addressing the loan-default problem, 33 higher-education groups have endorsed a statement, declaring: "It is important for policymakers to recognize that short-term solutions aimed a producing 'quick-fix' cost reductions will not result in an adequate long-term solution to the vexing problem . . . Greater participation of colleges and universities as lenders should be encouraged, and alternative methods of collecting loans such as the Internal Revenue Service or the Social Security system, should be explored."

Recommendation

For the security and welfare of the nation, Congress, state legislatures, governors, businesses, foundations, and others must continue to invest in a flexible mix of need and merit-based financial aid programs tailored to the varying needs of students.

Congress, in particular, must continue to reject all attempts from all quarters that would reduce the U.S. investment in student financial aid—an investment in people that left to mature will yield profits, while helping to assure a stronger and more robust nation. Such a policy will ensure that the United States maintains its commitment to affirmative action in higher education and its century and a quarter commitment to democratizing America's campuses.

. . . Minorities

They live in Watts and the West Side, Spanish Harlem, Anacostia, and elsewhere. They live in slums. They usually have just one parent—a mother. They spend most of their time on the streets—not in school—surrounded by neighborhoods infected with violence, crime, and drugs. They have babies when they're still teenagers. They are born in poverty—and most will live in poverty for the rest of their lives.

They are America's underclass.

And, they're the fastest-growing feature on America's demographic landscape.

"Those youngsters," observed a college president on the *ABC News* telecast *American Kids: Why They Flunk*, "who are not educated, not prepared, will not be able to adapt, they will, therefore, be unemployable. They'll be on the street. They'll be angry; they'll be dangerous."

The statistical portrait of this burgeoning underclass—described in a 1988 report by the American Council on Education (ACE) and the Education Commission of the States (ECS)—is stark:

✔ *Population Growth.* By 2000, about 42 percent of all public-school students will be minorities or victims of poverty.

✔ *Income.* In 1986, 31.1 percent of blacks had incomes below the poverty level nearly three times the rate for whites. Median black-family income in 1986 was only 57 percent that of whites—$17,604 compared to $30,809. Between 1973-86, average real annual earnings for black males, ages 20-24, fell 50 percent from $9,818 to $5,299, measured in 1985 dollars.

✔ *Joblessness.* The 1986 unemployment rate for blacks was 14.5 percent—more than twice the 6 percent rate for whites. As of April, 1988, the black jobless rate was trimmed to 12.2 percent, while the unemployment rate for whites stood at 4.6 percent.

✔ *Education.* Of the 1.05 million high-school seniors who took the Scholastic Aptitude Test (SAT), a college-entrance exam, in 1985—just over 70,000, or 9 percent, were black. Nearly three-quarters of the blacks who took the SAT scored below 400 points on the verbal section and just under two-thirds scored less than 400 points on the test's math section. For whites, 31 percent and 22 percent scored less than 400 points on the exam's verbal and math sections respectively.

✔ ***Higher Education.*** Blacks made up about 9 percent of all undergraduate students in 1984-85, but received only 6 percent of all bachelor's degrees. Between 1976-85, the number of blacks earning master's degrees fell 32 percent; the number of blacks earning doctorates dropped by 5 percent.

Retention & Student Aid

In an area critical to U.S. economic competitiveness and national security—computer science—the ACE/ECS study reported, only one black earned a doctorate out of 355 awarded nationally in 1986; blacks received only six of 730 doctorates awarded in the United States in 1986.

The National Conference of State Legislators (NCSL) notes that 61 percent of white youth entering college earn a degree; Mexican-Americans, 32 percent; Puerto Ricans, 28 percent; blacks, 24 percent.

"Black college students are nearly twice as likely to remain in four-year institutions if they receive financial assistance," NCSL notes in *Education and Economic Growth: A Legislator's Guide*. "In 1987, 48 percent of black college-bound seniors came from families with annual incomes under $12,000, compared with 10 percent of their white classmates."

Demographer Harold L. Hodgkinson points out that 29 percent more blacks graduated from high school in 1982 than in 1975—but black enrollment on the nation's campuses plummeted 11 percent during the same period. High-school graduation rates for Hispanics jumped 38 percent in the 1975-82 period—but Hispanic college enrollments sank 16 percent.

Historically Public Black Colleges

An important bridge to America's underclass is the nation's 35 historically public black colleges (HPBCUs). These institution's, located in 18 states, enroll nearly 25 percent of all black students in higher education and about 60 percent of those enrolled in predominately black colleges. HPBCUs award nearly 30 percent of all bachelor's degrees earned by blacks.

Each black college, on average, receives $1.8 million in federal funds—80 percent of which is student financial aid. State government invested about $535.7 million in these campuses in 1987-88.

HPBCUs continue to be strong magnets attracting underrepresented minority students to higher education. Enrollments climbed 3.5 percent in the 1987-88 school year, compared to a 0.4-percent decrease in 1986-87, according to a survey by NASULGC and the American Association of State Colleges and Universities (AASCU).

HPBCU enrollments reached 130,285 students in 1987-88, compared to 125,856 students in 1986-87. The 3.5-percent boost in HPBCU enrollments compares to a 1.9-percent enrollment hike at public, four-year campuses nationally in 1987-88. A surge in the number of freshmen attending HPBCUs fueled the enrollment increase.

Reasons For Enrollment Surge

NASULGC credited the enrollment boost to: "A growing number of black students are demonstrating greater interest in maintaining tradition and are opting to attend historically black campuses—recognizing them as vital educational and cultural centers. A number of campuses report that they are attracting more second generation college students, who frequently talk about continuing a family tradition by attending their parent's alma mater . . . Several campuses are reporting 5-percent to 48-percent increases in the number of applications they are receiving from students."

Among other key factors credited with affecting enrollment growth are: HPBCUs have become more academically competitive, offering a greater number of options in high-growth fields at reasonable cost and national student-recruitment campaigns have generated more information about black campuses.

Recommendation

Federal, state, and local government should recognize HPBCUs as a "national resource" especially well-suited to coping with the complex educational, social, cultural, and economic circumstances associated with America's disadvantaged.

These institutions should be viewed in the context of their century-long experience in successfully educating the disadvantaged and be assured the resources—personnel, facilities, and funds—to deliver a growing range of high-quality teaching, research, and public-service programs to a broad population, as an investment in America's future strength and prosperity.

. . . Research

"The power of American inventiveness—from the light bulb to the laser, from the tractor to the transistor—is legend. But now the rest of the world is determined to catch up . . . In the age of large-scale science, when research goals become national priorities and individual laboratory budgets can surpass the billion-dollar mark, the lone scientist still plays the central role in the process of inquiry that leads to breakthroughs."

That statement by *Fortune* magazine illustrates the proud history and rugged challenges facing the United States on the frontiers of science.

Research—across a broad range of scientific and engineering fields—fuels economic growth and prosperity . . . and also undergirds the nation's military defenses.

"Leading economists," declares the Council on Research and Technology (CORETECH), a coalition of 152 corporations, campuses, and higher-education associations, "now believe that the single biggest factor behind productivity growth is innovation, and they have demonstrated, two-thirds and possibly 80 percent of the productivity growth achieved since the Great Depression can be directly or indirectly attributed to innovation. In an industrialized society, research and development is the primary means by which technological innovation is generated."

Research & Development

The United States spent $127 billion on research and development (R&D) in 1987.

More than two-thirds of R&D spending ($82 billion), according to the Coalition for National Science Funding (CNSF), is for development and about one-third ($41 billion) is targeted to basic and applied research. About half of R&D is supported by the federal government and half is supported by industry.

University laboratories are where about half of all U.S. basic research—the source of new industrial products and processes—is performed; industry performs about 20 percent of basic research. The federal government funds two-thirds of all U.S. basic research, estimated at $15 billion. Additional sponsors of basic research are: industry, $3 billion; universities, $1.6 billion, and others, $700 million.

Industry accounted for 5 percent ($375 million) of basic research dollars spent by universities in 1986—three times the 1980 level. "This upward trend although encouraging, needs to continue if universities and companies are to begin to fully realize the advantages of working together," CORETECH notes. "Chief among those advantages is the acceleration of technology transfer."

Major Trends

The National Science Foundation (NSF) says these trends have characterized U.S. policy toward research and development (R&D) in recent years:

✔ The United States has not invested in R&D at the rate that sustained growth in a modern society requires.

✔ The proportion of U.S. federal research support earmarked for military purposes has climbed sharply during most of the 1980's.

✔ When military research is scratched from the nation's R&D total, as a fraction of GNP, the U.S. effort is less than West Germany's and Japan's.

✔ An increasing portion of U.S. dollars is targeted to basic research.

✔ Twenty years ago, the United States had far more scientists and engineers per capita than its competitors; that's no longer the case.

✔ In the past 20 years, the federal investment in university research facilities has plummeted 95 percent in real terms.

Health & Medical Research

America's tab for health care jumped 9.8 percent in 1987, reaching a half trillion dollars, according the U.S. Department of Health and Human Services. More than 11 percent of the U.S. Gross National Product (GNP) is consumed by health care—the highest level in U.S. history and the highest of any major developed nation. In 1965, health care represented only 5.9 percent of the GNP.

Despite this massive investment in health care, much needs to be done. Cancer is not cured. Alzheimer's Disease continues to steal memories of a lifetime. AIDS remains a frightening malady. Heart disease and stroke still afflict millions of people. Blindness and deafness deny people the ability to fully enjoy the world around them. Spinal injuries still condemn men and women to wheelchairs—or worse. And, many other illnesses are awaiting cures and new therapies under development at state and land-grant campuses.

Former White House Science Advisor George Keyworth in the mid-1980's told Congress that the "Biological sciences stand on the brink of understanding that I can only liken to the brink that Einstein saw for physics in 1905" with the development of the theory of relativity.

Animals & Research

Recently, controversy has swirled around a basic investigative tool used by medical detectives—laboratory animals.

Newsweek reports that at least 17 million animals are used in laboratory experiments each year; 85 percent are rats and mice.

Advocates, concerned about the welfare and compassionate treatment of creatures used and sacrificed in medical research, have taken extreme steps—including sit-in demonstrations and thefts of records and subjects from laboratories—to argue their case publicly. While university researchers remain committed to the highest standards of ethics and respect for all life, lawmakers and the public must understand that without the careful and cautious use of animal subjects medical research will be stymied and new cures and therapies for a long list of life-threatening diseases will remain elusive.

A businessman in his forties, the recipient of a heart transplant, put it this way: "I remembered, from keeping up with the news, that the initial heart transplant work was done in dogs by Dr. Christian Barnard in South Africa. . .," adding that " . . . if the use of animals in research saves human lives, then it is worthwhile."

"Since 1901," *Newsweek* reports, "57 Nobel prizes for physiology and medicine have been awarded for research done at least in part with animals. Pigs were used to develop the CAT scan; rabbits to understand the rejection of organ transplants. Researchers used monkeys and mice to develop the polio vaccine; rabbits and mice helped create sulfa drugs. Surgical advances in sutures and grafts have been made using dogs; dogs and rabbits aided the discovery of insulin and in understanding the mechanism of diabetes."

Keeping Science Honest

Honesty in science—especially biomedical research—forms the basic bond between the public and researchers; a bond forged in credibility and confidence.

Consequently, allegations of fraud and misconduct in the nation's laboratories have, at times, tarnished the luster of America's scientific accomplishments and undermined the public's basic faith and trust in America's scientific establishment.

While the extent of the problem remains unknown, Congress reported in 1988 that the National Institutes of Health (NIH) is averaging two cases a month involving charges of scientific fraud and misconduct. While these matters raise difficult questions of ethics and integrity, they also can involve life and death issues and the possible misuse of taxpayer dollars.

Rigorous standards of excellence—vigorously, fairly, and impartially administered by colleges and universities—can provide public safeguards without inhibiting the freedom needed for serious scientific investigation.

A *Washington Post* editorial observed: "Would-be regulators agree that it would be better for academic institutions to police themselves . . . Now there is movement by universities not only to expedite investigations but to address some general problems that foster error and misconduct: the pressures on young scientists to grind out research papers; the structure of labs where senior scientists have no direct responsibility for research that bears their name. By cleaning up their act, academic scientists may ward off government interference that could do them great harm."

Research & Defense

As long as the balance of power among nations remains tenuous and government budgets remain limited, rancorous debate over military spending and strategy will continue to be a political fact of life.

This debate has taken place at other times in U.S. history—and in other nations. It continues to be at the center of controversies in parliaments and politburos worldwide. In a federal budget topping $1 trillion, military preparedness carries a price tag of more than $300 billion in the fiscal 1990 federal spending blueprint.

The United States has maintained, by means of the most advanced and sophisticated arsenal, its capacity to deter nations that would threaten this nation, its allies, and the general peace.

In recent years, this arsenal has been significantly modernized and enlarged at a cost of about $1.6 trillion, adding to it "high-tech" tanks and helicopters; tactical, intermediate, and ballistic missiles; high-speed fighter aircraft, long-range bombers, deep-diving attack and missile-firing submarines, and other weapons. A former U.S. defense secretary explained: "Given our disadvantage in numbers, our technology is what will save us."

The fundamental scientific theory on which the engineering that produces such technology is based usually originates in the laboratories and classrooms of university mathematicians, physical scientists, and engineers.

In addition to fundamental scientific research that adds muscle to U.S. defenses, education plays another pivotal role in military security. Operation of "high-tech" weapons takes sophisticated knowledge on the part of troops—large numbers of whom receive their training in traditional and special programs at higher-education institutions. Today's "top guns" have little in common with yesteryear's aces and barnstorming pilots.

Facilities

"University research facilities . . .," CORETECH observes, "are all too often antiquated and inadequate and the instrumentation and equipment used are frequently not state-of-the-art. Direct federal support of R&D physical plant in universities fell from $211.7 million (in 1972 constant dollars) in 1966, to $19.5 million in 1981."

A 1988 survey by the National Association of College and University Business Officers (NACUBO) and the Association of Physical Plant Administrators (APPA) indicated that U.S. campuses have a $20 billion backlog in urgently needed repairs to facilities and that total capital renewal and replacement costs could be valued at $60 billion to $70 billion.

NACUBO and APPA point out that "for every $1 spent on maintenance in 1988 budgets, $4 was deferred by colleges and universities."

A National Science Board official pointed out the importance of top-notch facilities for education and research, noting that "we cannot do micro-electronics without clean rooms with air 100,000 times as pure as normal rooms, and with floors virtually free from vibration; we cannot do chemistry and biology without special ventilation and waste disposal facilities; we cannot do large-scale computation without computer rooms with carefully controlled environments."

Engineering & Scientific Manpower

The United States, two decades ago, led its economic competitors in the number of scientists and engineers relative to its population. But, today, Japan—with half the U.S. population—produces more engineers than the United States.

Only 45 percent of new engineering graduates, earning doctorates at American universities are U.S. citizens. And, more than 50 percent of junior engineering faculty in the United States are citizens of foreign nations.

A 1989 assessment of the math and science skills of students in various countries—*A World of Differences*—revealed that U.S. students perform well below the mean. "Despite their poor overall performance [in math]," the report observed, "about two-thirds of the United States' 13 year olds feel that 'they are good at mathematics."

Therefore, to rectify these problems, and help ensure that the United States has the scientific and engineering brainpower to spur the technical innovation needed to make the United States more competitive in the global marketplace, and adequately provide for the national defense, it is recommended that:

✔ National policy set as a goal an annual increase of 1,000 in the number of students earning engineering doctorates who are U.S. citizens.

✔ To accomplish this goal, a federal investment of $25 million—climbing in four years to $100 million annually—is needed to support 4,000 engineering doctoral candidates with yearly fellowships of $18,000 plus cost-of-education allowances to participating campuses of $7,000 annually.

✔ A National Commission on the Crisis in Engineering Graduate Education should be established, composed of leaders from industry and higher education. The commission's mandate would be to make recommendations to the federal government and campuses designed to support graduate engineering education. Since America's public universities produce three-quarters of the nation's engineering doctoral graduates, it is proposed that the commission operate under the auspices of the National Association of State Universities and Land-Grant Colleges (NASULGC).

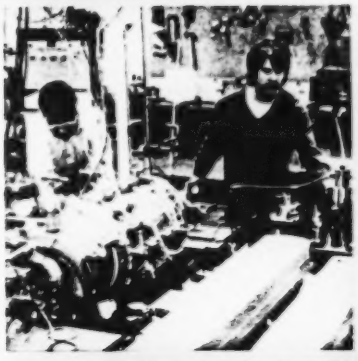
It also should be noted that professional shortages comparable to that of engineering exist in other critical disciplines such as physics, chemistry, and biology.

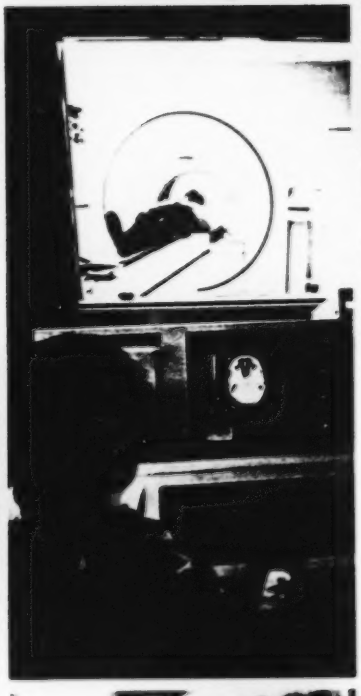
Recommendation

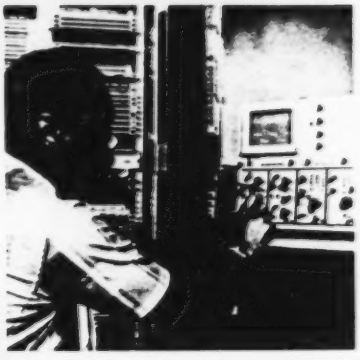
Federal support for a broad range of scientific and engineering research programs should be crafted with a clear eye on national economic, health, social, and defense requirements, as well as the world-class capabilities of America's state and land-grant universities. The federal government should encourage the conduct of basic, applied, and clinical research that meets only the strictest and most rigorous standards of excellence.

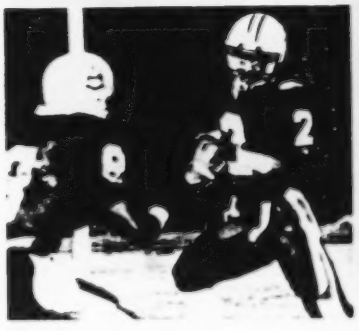
Policies should be guided by the goal of enhancing campus-based research capabilities across a balanced spectrum of disciplines.

Policies also should be devised to help ensure new generations of talented scientific and engineering professionals—professionals whose career research interests will keep the United States in the forefront of scientific and technical innovation.









Alabama

Alabama A&M University*
Auburn University*
Tuskegee University
University of Alabama System
University of Alabama in Birmingham
University of Alabama, Tuscaloosa

Alaska

University of Alaska Statewide System*
University of Alaska, Fairbanks

Arizona

Arizona State University
University of Arizona*

Arkansas

University of Arkansas System
University of Arkansas at Pine Bluff*
University of Arkansas, Fayetteville*

California

University of California Systemwide*
University of California, Berkeley
University of California, Davis
University of California, Irvine
University of California, Los Angeles
University of California, Riverside
University of California, San Diego
University of California, Santa Barbara

Colorado

Colorado State University*
University of Colorado
University of Colorado, Boulder

Connecticut

Connecticut Agricultural Experiment Station*
University of Connecticut*

Delaware

Delaware State College*
University of Delaware*

District of Columbia

University of the District of Columbia*

Florida

Florida A&M University*
Florida State University
State University System of Florida
University of Florida*
University of South Florida

Georgia

Fort Valley State College*
Georgia Institute of Technology
University of Georgia*

Guam

University of Guam*

Hawaii

University of Hawaii*

Idaho

University of Idaho*

Illinois

Southern Illinois University System
Southern Illinois University at Carbondale
University of Illinois at Chicago
University of Illinois at Urbana-Champaign
University of Illinois*

Indiana

Indiana University
Purdue University*

Iowa

Iowa State University*
University of Iowa

Kansas

Kansas State University*
University of Kansas

Kentucky

Kentucky State University*
University of Kentucky*
University of Louisville

Louisiana

Louisiana State University System*
Louisiana State University, Baton Rouge
Southern University System*

Maine

University of Maine System
University of Maine*

Maryland

University of Maryland, Central Administration*
University of Maryland, College Park
University of Maryland, Eastern Shore*

Massachusetts

Massachusetts Institute of Technology*
University of Massachusetts*
University of Massachusetts, Amherst

Michigan

Michigan State University*
University of Michigan
Wayne State University

Minnesota

University of Minnesota*

Mississippi

Alcorn State University*
Mississippi State University*
University of Mississippi

Missouri

Lincoln University*
University of Missouri*
University of Missouri, Columbia
University of Missouri, Kansas City
University of Missouri, Rolla

Montana

Montana State University*
University of Montana

Nebraska

University of Nebraska*
University of Nebraska, Lincoln

Nevada

University of Nevada, Reno*

New Hampshire

University System of New Hampshire
University of New Hampshire*

New Jersey

Rutgers, The State University of New Jersey*

New Mexico

New Mexico State University*
University of New Mexico

New York

City University of New York
Cornell University*
State University of New York System
State University of New York, Albany
State University of New York, Binghamton
State University of New York, Buffalo
State University of New York, Stony Brook

North Carolina

North Carolina A&T State University*
North Carolina State University*
University of North Carolina
University of North Carolina at Chapel Hill

North Dakota

North Dakota State University*
University of North Dakota

Ohio

Bowling Green State University
Kent State University
Miami University
Ohio State University*
Ohio University
University of Cincinnati
University of Toledo

Oklahoma

Langston University*
Oklahoma State University*
University of Oklahoma

Oregon

Oregon State System of Higher Education
Oregon State University*
University of Oregon

Pennsylvania

Pennsylvania State University*
Temple University
University of Pittsburgh

Puerto Rico

University of Puerto Rico*

Rhode Island

University of Rhode Island*

South Carolina

Clemson University*
South Carolina State College*
University of South Carolina

South Dakota

South Dakota State University*
University of South Dakota

Tennessee

Tennessee State University*
University of Tennessee*
University of Tennessee, Knoxville

Texas

Prairie View A&M University*
Texas A&M University System
Texas A&M University*
Texas Tech University
University of Houston
University of Houston System
University of Texas System
University of Texas, Austin

Utah

University of Utah
Utah State University*

Vermont

University of Vermont*

Virgin Islands

University of the Virgin Islands*

Virginia

University of Virginia
Virginia Commonwealth University
Virginia Polytechnic Institute & State University*
Virginia State University*

Washington

University of Washington
Washington State University*

West Virginia

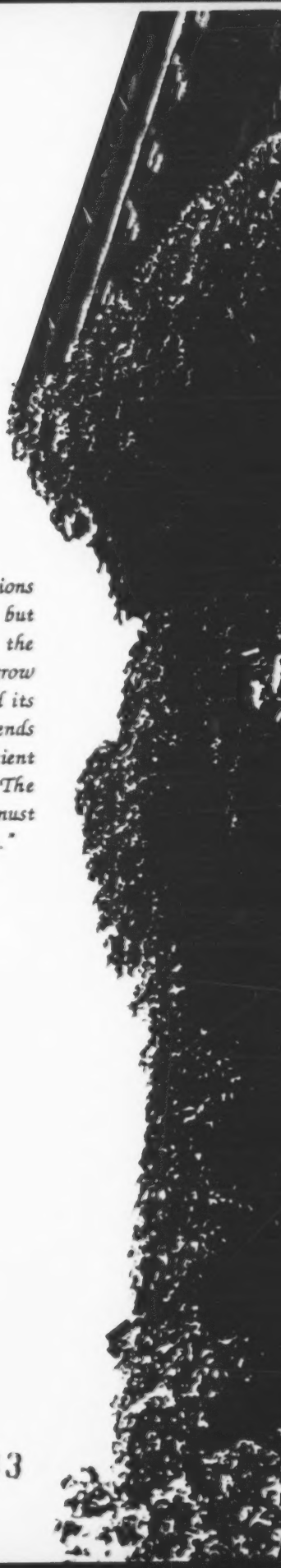
West Virginia University*

Wisconsin

University of Wisconsin System
University of Wisconsin-Madison*
University of Wisconsin-Milwaukee

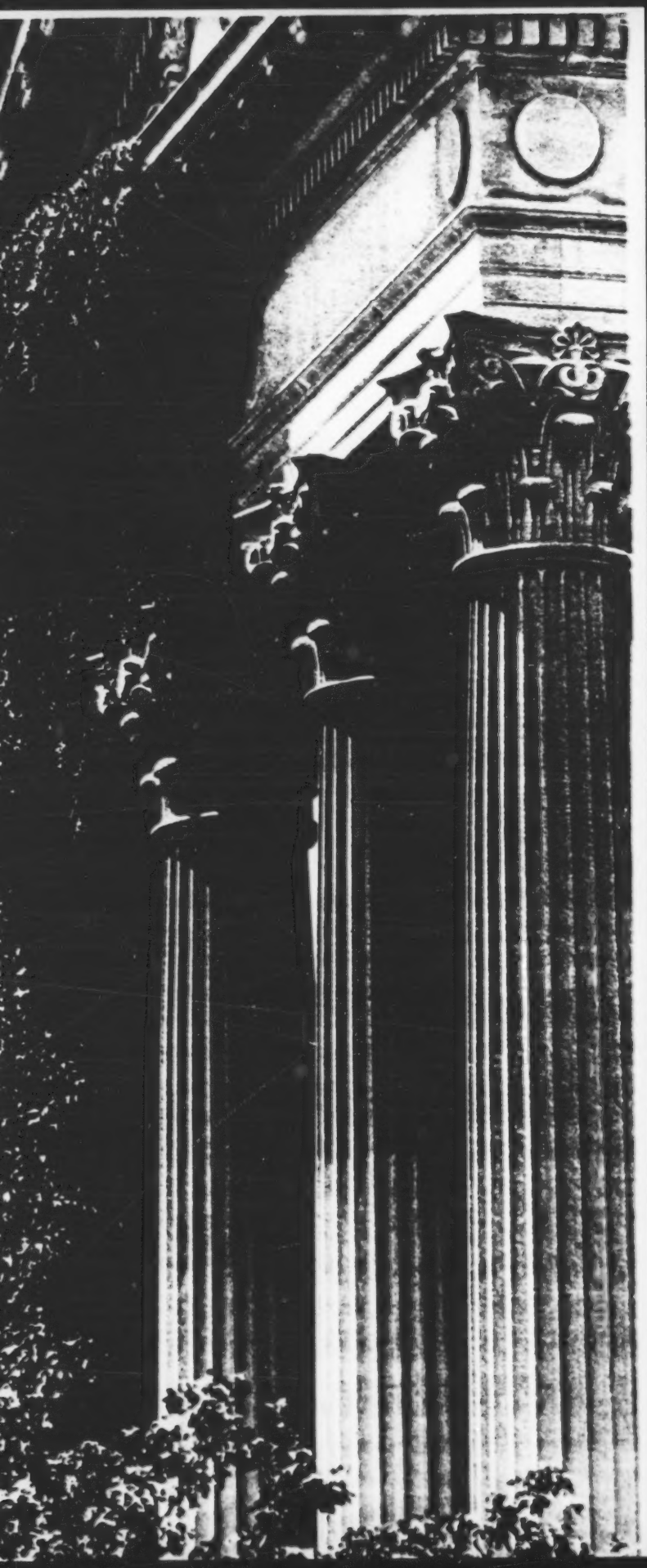
Wyoming

University of Wyoming*



". . . The service of institutions of learning is not private, but public. It is plain what the nation needs as its affairs grow more and more complex and its interests begin to touch the ends of the Earth. It needs efficient and enlightened men. The universities of the country must take part in supplying them."

Woodrow Wilson



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William A. Shayka, U.S. Navy
Richard Frasier
Third Row, (left to right): West Chester Area School District, West Chester, PA
Richard Frasier
Fourth Row: Jim Kirby

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